

2012 American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, Dec 3-7, 2012.

Website: <http://fallmeeting.agu.org/2012/>

Sponsored by: AGU, 2000 Florida Avenue N.W., Washington, DC 20009-1277

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## **Dipole Alignment in Rotating MHD Turbulence**

John V Shebalin<sup>1</sup>, Terry Fu<sup>2</sup>, Lee Morin<sup>3</sup>

<sup>1</sup>Astromaterials Research, NASA JSC, Houston, TX, United States.

<sup>2</sup>Physics, University of Houston, Houston, TX, United States.

<sup>3</sup>Astronaut Office, NASA JSC, Houston, TX, United States.

Abstract: We present numerical results from long-term CPU and GPU simulations of rotating, homogeneous, magnetohydrodynamic (MHD) turbulence, and discuss their connection to the spherically bounded case. We compare our numerical results with a statistical theory of geodynamo action that has evolved from the ‘absolute equilibrium ensemble theory’ of ideal MHD turbulence, which is based on the ideal MHD invariants are energy, cross helicity and magnetic helicity. However, for rotating MHD turbulence, the cross helicity is no longer an exact invariant, although rms cross helicity becomes quasistationary during an ideal MHD simulation. This and the anisotropy imposed by rotation suggests an ansatz in which an effective, nonzero value of cross helicity is assigned to axisymmetric modes and zero cross helicity to non-axisymmetric modes. This ‘hybrid statistics’ predicts a large-scale quasistationary magnetic field due to ‘broken ergodicity’, as well as dipole vector alignment with the rotation axis, both of which are observed numerically. We find that only a relatively small value of effective cross helicity leads to the prediction of a dipole moment vector that is closely aligned ( $< 10$  degrees) with the rotation axis. We also discuss the effect of initial conditions, dissipation and grid size on the numerical simulations and statistical theory.